and about 6 inches wide at the surface, tapering off to nothing at the bottom. The main discharge apparently was at B, as all connected branches radiate from that point. A^1, A^2, and A^3 are gaps in the branches where the turf is not disturbed in any way. Apparently at these places the discharge passed underneath the surface to resume its course again on the surface later on. There was no connection at the surface between B and I. Careful probings at I with a 6-foot collapsible carpenter's rule, which is in 6-inch sections, failed to reveal any hole.

By probing at B a hole was found, almost perpendicular, 43 inches in depth, but slanting a little with descent to the east-northeast, which must have been nearly straight throughout its course, otherwise the rule having flexibility in only one direction and a width of five-eighths inch in the other direction, could not have followed it. With the facilities at hand it could not be determined how much deeper, if any, this hole extended.

At C a hole was found 31 inches long, directed down slope toward K, 6 inches to 8 inches below the surface and nearly parallel to it. At D a hole was discovered extending 22 inches in the general direction of B but nearly horizontal.

The sod at F was severed in a clean-cut line for about 2 feet. The turf was carefully laid back by hand on each side of the line exposing a cavity about 1½-inches deep and 2 inches across. At J the terminus of a branch, there was a spot about three-eighths inch in diameter but prodding with the rule failed to indicate any depth to it. The branches GHI, and all ramifications on the green had no depth, the only evidence of the discharge being the searing of the grass which was changed to a yellowish brown color down to the roots, the path having a width decreasing from about three-eighths inch in the early part of its course to three-sixteenths of an inch at the ends. In the cavities at C and F, the grass roots were whitish, nearly their natural color, but were not scorched or blackened at all. Examination at B and other places where the sod was broken failed to reveal any fusing or discoloration of the soil.

The cloud layer from which the lightning discharge took place moved from the WSW to ENE and the hole at B, made by the discharge, had a slight inclination to the ENE.

The nearest trees to the eighteenth green are roughly 60 feet in height and distant about 150 feet. It seems somewhat strange that the discharge missed these inviting trees. It is perhaps more remarkable, however, that the flag marking the eighteenth hole, on a pole about 10 feet long, which was distant about 25 feet from the point where the lightning struck, should have escaped.

Many bolts of lightning strike the ground but relatively few accounts have been published regarding them. One case occurred at the Agricultural Experiment Station at College Park, Md., an account of which is published in

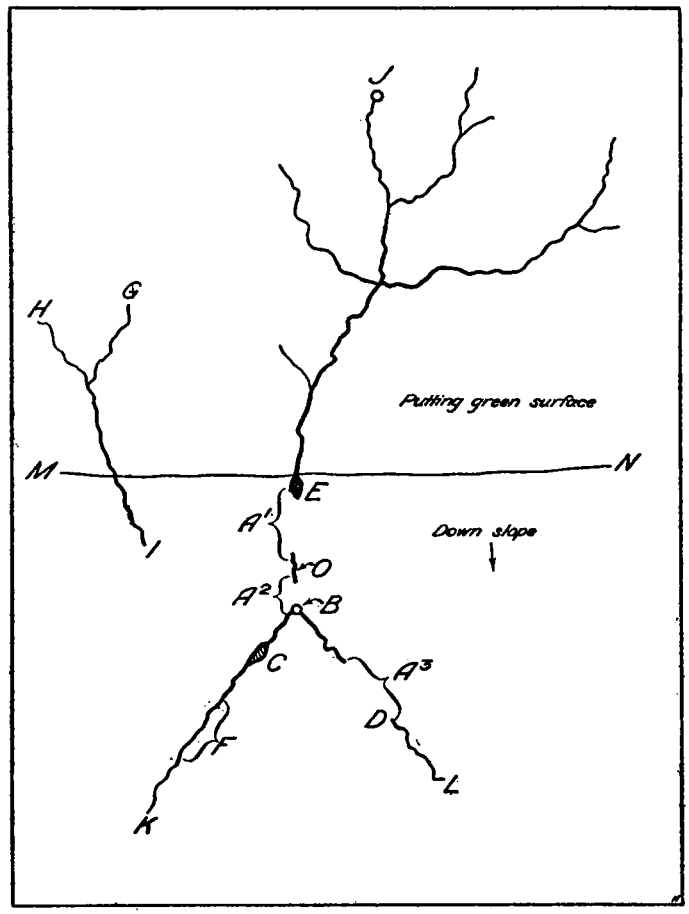

FIGURE 1.—Ramifications of lightning. B indicates point where lightning discharge struck the earth. MN delimits putting green surface.

the MONTHLY WEATHER REVIEW, volume 48, page 452, 1920.

Perhaps some of the most interesting cases are where the lightning strikes in sand and by its intense heat forms irregular glass tubes commonly known as "fulgurites" and which may have a diameter up to 2 inches or slightly more.

SOME OBSERVATIONS OF THE SUN THROUGH A DUST STORM

By C. T. ELVEY

[Yerkes Observatory, Williams Bay, Wis., June 1934]

The dust storm of May 10, 1934, presented an opportunity to the astronomer to make a comparison of a terrestial phenomenon with certain astronomical observations. An observer of the Milky Way sees that it is not uniform but cut in many places by dark patches. On photographs these dark areas and many others of smaller dimensions are evident, and a careful study of them shows that they are caused by the presence of cosmic dust clouds which cut out a part of the light of the stars which are behind them. A study of the character of the light that has traversed a cloud of dust gives some information concerning the particles composing the cloud. Particles which are less in diameter than the wave-length of the incident light scatter the light according to Rayleigh's law, that is in proportion inversely to the fourth power of the wave length, and consequently the transmitted light is redder than the incident light. If the particles are large in comparison with the wave-length of light, the scattering is independent of the wave-length and thus the color of the transmitted light is the same as that of the incident light. If the particles are of intermediate sizes the scattering is inversely proportional to the first, second, and third powers of the wave-length, but, as E. Schönberg [1] has shown, the range in size of such particles is small. Thus for a uniform mixture these intermediate powers may be neglected. Observations of the colors of the stars have shown some to be excessively reddened in

[1] Mitt. d. Sternwarte Breslau, 3, 53, 1932.

comparison with the total obstruction of light while others show large diminution of light with only a slight amount of reddening.

When the dust storm of May 10 covered a large section of the Middle West one could see the sun shining faintly through the dust cloud and to the eye the color of the sun appeared to be bluer than normal. Professor Struve suggested that I try to obtain an accurate measure of the color of the sun through the cloud with the photo-electric photometer, in order to test whether this apparent departure from the laws of light scattering was real.

The photo-electric photometer of the Yerkes Observatory has been described by Dr. Joel Stebbins.[2] It contains a sensitized potassium photo-electric cell and for measuring colors a pair of filters is used which, when combined with the sensitivity-curve of the cell, give effective wave-lengths of 4250 A for the blue filter and 4750 A for the yellow one. In order to make observations on the sun without damage to the photo-electric cell the 12-inch telescope on which the photometer is attached was diaphragmed to an aperture of 3 inches for observing the sun through the dust cloud and to ¼ inch when the sun was at normal brightness. For further decreasing the intensity of the light falling on the cell it was necessary to place near the focussed image of the sun an aperture of 2 mm which allowed only a small area of the disk of the sun to fall on the cell. Immediately following the aperture was a "flashed" opal diffusing screen. The potential on the cell was reduced from the usual 176 volts to 19½ volts. Precautions were taken that no light could leak into the photometer.

The observations for color were made in the usual manner, measuring the brightness of the sun through the filters: first, once through the yellow one, then twice through the blue, twice through the yellow, twice through the blue and finally once more through the yellow filter, thus giving four readings through each filter. The relative brightnesses are then expressed in stellar magnitudes which give a measure of the color of the object. Since we are interested in a change in the color of the sun from the normal it is necessary to observe it at exactly the same altitude on a day when the sky is free from dust and clouds. This occurred 5 days later. In the meantime the photometer was left unchanged so as to introduce as few variables as possible into the comparison.

Two sets of observations were taken each on May 10 and on May 15, the date for comparison. The observed color of the sun through the dust cloud was $+0.83 \pm 0.03$ (average deviation) magnitudes. On May 15, when the transparency of the sky was judged as excellent for photometric purposes, the color of the sun was $+0.89 \pm 0.01$ magnitudes. The sense of the sign is such that larger positive numbers represent redder colors. Thus, it is seen that, if there is any change at all, it is in the direction of the sun being bluer as seen through the dust cloud. However, considering the difficulties involved and also considering the average deviations I would say that there had been no change in color. The difference is nearly equal to the sum of the average deviations. We can then conclude that there was an insufficient amount of dust fine enough to produce Rayleigh scattering even though the brightness of the sun was reduced to less than one percent [3] of its normal brightness. All of the dust particles must be larger than a few microns in diameter. This is perhaps what might have been expected since the dust was more or less of local origin, being picked up by the high winds over the drought stricken areas of the Great Plains. A sample of the dust falling here was collected by Dr. Keenan and an examination with a microscope showed that most of the particles averaged about 0.1 mm. in diameter.

The apparently decided blue color of the sun as seen visually through the dust cloud is merely an effect of contrast. One ordinarily sees the sun projected against a blue sky and of course the sun is yellower than the sky. The dust cloud had a brownish color and consequently the sun by contrast appeared bluer than normal.

[2] Astrophysical Journal, *74*, 289, 1931.

[3] This is determined from a comparison of the observations of the two days, taking into account the areas of the apertures admitting light to the telescope objective. The accurate comparison shows that the brightness of the sun as seen through the dust cloud at 9:43 a.m. C.S.T. on May 10 was 0.8 of 1 percent as bright as on May 15 at the same zenith distance.

THE TROPICAL DISTURBANCE OF JUNE 5–23

By G. E. DUNN

[Weather Bureau, Washington, Aug. 6, 1934]

The early history of this storm remains rather obscure. Disturbed conditions were noted in the Gulf of Honduras on the 4th and, as the depression had deepened and some movement was apparent, advices were issued the morning of the 5th, the day it crossed the coastline of British Honduras near Belize, where a maximum wind of 34 miles from the northwest was recorded. During that afternoon and night it apparently turned to the southwestward or south. On the morning of the 6th Tapachula, on the coast of Mexico, near the Guatemalan border, reported a barometer reading of 29.6 inches and a 24-hour fall of 0.18 inches. On June 7 the following message was received from the Pan American Airways station at San Salvador, Salvador:

> A severe storm struck this place early this morning with torrential rain and winds in excess of 50 miles per hour. Present wind south 30 miles per hour. Considerable damage reported due to heavy rain.

Press reports indicate that between 1,000 and 3,000 persons were killed or injured in Honduras, perhaps due to floods in the majority of cases. The town of Ocotepeque in western Honduras suffered greatly, with more than 500 people killed. Only the church remained standing after the flood. The rainfall, according to some reports, was in excess of 25 inches at a number of places. Great destruction and suffering occurred in both Salvador and Honduras.

Because of the extreme paucity of reports from this area considerable conjecture is necessary, but the disturbance may have moved southwestward or southward from British Honduras to the Guatemalan or Salvadorean coast, intensified along their Pacific coasts, and recurved inland again over Salvador, crossed Honduras and passed northward into the Gulf of Honduras where it was definitely located on the 8th. During its passage over this Gulf it apparently regained hurricane intensity once more and then passed inland over the extreme northern portion of British Honduras in the late afternoon of the 8th. On the 9th it crossed the Yucatan peninsula and moved into the Gulf of Mexico. The Mexican Meteorological Service reported that winds of hurricane force occurred over a portion of the peninsula.

During the next 2 days this disturbance continued to move northwestward, but on the 12th made a complete